**Design, manufacturing, and validations of 4D printed medicines using smart materials for drug delivery applications**

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**Abstract**

This work focuses on the extrusion of a flexible or brittle polymer i.e., Polyurethane (PU) and Eudragit S100 (S100) to prepare filament using the Hot-melt extruded filament (HME). Hence, before going to HME it is necessary to have appropriate knowledge of polymer miscibility. Based on the theoretical calculations, the solubility parameter approach was performed as a preliminary step for the prediction of miscibility between PU and S100. After that, we will go through the HME process. We fabricate Seven filaments without plasticizers evaluated by a texture analyser to study the correlation between mechanical properties. Two different texture analysis methods were utilized and compared, and a parameter “toughness” calculated by tensile test or three-point bending test (3PBT). 3PBT It shows the tensile behaviour of the filament and detects non-brittle filament. This makes it unsuitable for FDM printing, and the most suitable filament was found, which is PU:S100\_70:30, it showed good mechanical stiffness for SMF. To assess the feedability, extrudability and printability of smart material fibers. There are no thermal and chemical degradation of the polymer observed after extrusion confirmed by DSC, XRD and FTIR analysis.

**Keywords**: Shape memory filaments, Polyurethane and Eudragit S100 composite

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Figure 1. (a) Diagram of twin-screw HME (b) Fabricated SMFs using different polymer ratio



Figure 2. graphical abstract for all fabricated SMFs